

have a projection along the growing margin of the umbilical callus. As a result, *P. amiculatus* lacks a spiral ridge within its umbilicus, and the umbilicus is more open than in *P. hacketti*, thus exposing earlier whorls within the umbilicus to a greater degree.

This species is named in memory of John P. Hackett, Jr., a friend, college classmate and fellow geologist killed in a helicopter crash on the Alaskan North Slope on June 30, 1974.

Naticinae Gray, 1834

Natica Scopoli, 1777

Natica (Natica) kanakoffi Marincovich, spec. nov.

(Figures 12 to 15)

Diagnosis: *Natica kanakoffi* is characterized by the combination of its globose form, broadly open umbilicus exposing earlier whorls, arched or angulate margin of its umbilical sulcus, and relatively thick parietal callus.

Description of Holotype:

Shell globose, spire moderately elevated; body whorl moderately inflated, evenly rounded; shell thickness average; whorls $3\frac{1}{2}$ (apex eroded); suture moderately impressed. Shell essentially smooth but with minute, very weak, closely and irregularly spaced costellae, and axial incremental growth lines that coarsen in the umbilical

area. Parietal callus thick, heavily filling posterior apertural angle; anterior lobe of callus weak, slightly overhanging umbilicus. Umbilicus broadly open, exposing earlier whorls; sulcus broadly curved but shallow; channel broad, not tapering toward inner lip. Umbilical callus small, funicle low but distinct. Anterior inner lip and basal lip thickened. Height 19.3 mm, diameter 19.8 mm.

Type locality: CAS locality 168, about 16 km northwest of Scappoose, northeast corner section 36, T4N, R3W, Willamette Base, Columbia County, Oregon. Lower Miocene, Scappoose Formation.

Type material: Holotype, CAS 55794; 1 paratype, CAS 55795; 2 paratypes, USNM 219433 and 219434; 2 paratypes, UCB 14213 and 14214; 2 paratypes, LACM 5044 and 5045.

Referred material: CAS 168, 16 km northwest of Scappoose, Oregon, Scappoose Formation, lower Miocene, 69 specimens; USGS Cenozoic locality M1975, near Scappoose, Oregon, Scappoose Formation, lower Miocene, 17 specimens; USGS Cenozoic locality M1498, Montesano quadrangle, Washington, Astoria Formation, middle Miocene, 1 specimen; UCB 31997, 31998, and 31999, Astoria, Oregon, Astoria Formation, middle Miocene, 3 specimens.

Discussion: The holotype (Figure 12) is average in size for this species. The largest known specimen (UCB 31997) is 44.1 mm in height and 43.4 mm in diameter, whereas the smallest specimen (CAS 168) has a height of 8.9 mm and a diameter of 9.0 mm.

Explanation of Figures 12 to 22

Figure 12: *Natica (Natica) kanakoffi* Marincovich, spec. nov. Holotype, CAS 55794, Scappoose Formation, lower Miocene, Oregon; height 19.3 mm

Figure 13: *Natica (Natica) kanakoffi* Marincovich, spec. nov. UCB 31998, Astoria Formation, middle Miocene, southwestern Washington; height 35.7 mm

Figure 14: *Natica (Natica) kanakoffi* Marincovich, spec. nov. UCB 31999, Astoria Formation, middle Miocene, southwestern Washington; height 16.8 mm. Note strongly developed umbilical callus and deep sulcus above it.

Figure 15: *Natica (Natica) kanakoffi* Marincovich, spec. nov. Paratype, LACM 5044, Scappoose Formation, lower Miocene, Oregon; height 15.5 mm

Figure 16: *Natica (Naticarius) teglandi* Hanna & Hertlein, 1938. Holotype, UCB 32215, Blakeley Formation, upper Oligocene, Washington; height 26.0 mm

Figure 17: *Natica (Naticarius) teglandi* Hanna & Hertlein. Para-

type, UCB 32190, Blakely Formation, upper Oligocene, Washington; height 20.5 mm

Figure 18: *Natica (Naticarius) posuncula* Hanna & Hertlein, 1938. Holotype, CAS 7084, Temblor Formation, Kern County, California, Miocene; height 22.0 mm

Figure 19: *Natica (Naticarius) posuncula* Hanna & Hertlein. From UCB locality 2713, Temblor Formation, Kern County, California, Miocene; height 20.1 mm

Figure 20: *Natica (Naticarius) uvasana* Gabb, 1864. Lectotype, ANSP 4233, Tejon Formation, Tejon, California, upper Eocene; height 9.7 mm

Figure 21: *Natica (Naticarius) uvasana* Gabb. Paralectotype, AN SP 4233, Tejon Formation, Tejon, California, upper Eocene; height 7.0 mm

Figure 22: *Natica (Naticarius) uvasana* Gabb. Paralectotype, AN SP 4233, Tejon Formation, Tejon, California, upper Eocene; height 10.0 mm



Figure 12



Figure 13



Figure 14



Figure 15



Figure 16



Figure 17



Figure 18



Figure 19



Figure 20

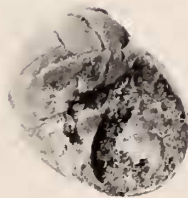


Figure 21



Figure 22

Shell form is consistent in *Natica kanakoffi*, with the only distinctive variation seen in the shape of the sulcus that indents the inner lip above the umbilical callus. The sulcus of the holotype and that of most specimens (*e. g.*, Figure 15) is a smooth arc that shallowly indents the inner lip and forms the posterior limit of the umbilical callus. However, a few specimens have the sulcus more deeply excavated and instead of being a smooth arc the sulcus is an angular indentation with the apex of the angle at the midpoint of the sulcus. Such an angular sulcus is seen best in Figures 13 and 14. An angular sulcus may be seen on individuals of all sizes, but is best developed on large specimens.

As noted above, *Natica kanakoffi* is known only from beds of lower and middle Miocene age in Oregon and Washington, in strata of the Scappoose and Astoria Formations. It is most similar in form to three lower and middle Tertiary species of western North America: *Natica (Naticarius) teglandi* Hanna & Hertlein, 1938 (Figures 16 and 17), *Natica (Naticarius) posuncula* Hanna & Hertlein, 1938 (Figures 18 and 19), and *Natica (Naticarius) wvasana* Gabb, 1864 (Figures 20 to 22). *Natica (Natica) kanakoffi* differs from these 3 species by lacking the axial wrinkles below the suture that places these species in *Naticarius*. It further differs by having an umbilicus so broadly open that most earlier whorls are visible within it; only *N. teglandi* approaches this condition, and never to the extent seen in *N. kanakoffi*. Whereas the umbilical sulcus of *N. kanakoffi* is a smooth arc or an angulation, the sulci of the other 3 species form essentially straight lines along the posterior inner lips (see Figures 17, 18, and 21). The umbilical calluses of these 3 species are also much more robust than that of *N. kanakoffi*, with the exception that some specimens of *N. teglandi* have calluses as subdued as that of *N. kana-*

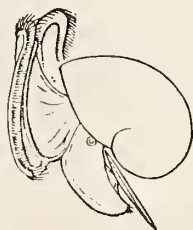
koffi. As a final point, the parietal callus of *N. kanakoffi* is much thicker than on any of the other species, and more heavily fills the posterior apertural angle. The opercula of these 4 species are unknown.

Natica kanakoffi is not closely similar to any living species in the eastern Pacific, and there are only two other species of *Natica*, *s. s.*, in this region. However, *Natica*, *s. s.*, is a distinctly tropical subgenus worldwide at present, and its occurrence as *N. kanakoffi* in the early and middle Miocene of Oregon and Washington is indicative of the warm climate that prevailed there during the middle Tertiary.

This species is named in honor of the late George Kanakoff, who encouraged my early interest in mollusks.

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An Illustrated List of the Phyllidiidae from Seto, Kii, Middle Japan

(Nudibranchia : Doridoidea)

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(5 Text figures)

THE SOUTH-WESTERN COAST LINE of the province of Kii (now called Wakayama-ken) faces closely on the main stream of Kuro Siwo. And, hence, it has been found inhabited by a series of forms which, fundamentally, characterized the biology of the circumequatorial zone of the land and sea. Needless to say, the family Phyllidiidae constitutes one of the representatives of the nudibranch fauna of the tropical Indian and Pacific Oceans where coral reefs appear to supply suitable conditions for the animals of this family to live. The present paper reports a collection of 4 species of the Phyllidiidae from the vicinity of the Seto Marine Biological Laboratory of the Kyoto University. External taxonomic features, distributional notes and line drawings of the animals are given for each species. The specimens used for this study were obtained by the members of the Aquarium attached to the Biological Laboratory to whom we are deeply indebted.

1. *Phyllidia varicosa* Lamarck, 1801

(Japanese name: Tatehida-iboumiushi)

(Figure 1)

Main Synonymy:

Phyllidia varicosa. EDMUNDS, 1971: 388 - 389; fig. 23. - Tanzania

Distribution: Red Sea; east coast of Africa; various stations of the Indian Ocean; various stations of the south-western Pacific; and Hawaii. In the Japanese waters this species occurs in Ishigaki-shima of Okinawa (BABA, 1936) and Ogasawara (= Bonin) Islands (collector: the Fisheries Faculty of the Miye University).

Material Examined: One specimen collected from Seto (33°41' N; 135°21' E), Kii, July 30, 1961.

Brief Description: Length of the animal 100 mm. Back with 3 longitudinal ridges, each bearing a row of large warty tubercles. Anus dorso-median, posterior. Ground-colour of the back bluish white. On about the median part there are 4 longitudinal bands of deep blue which separate the above-mentioned ridges from each other and from the sides of the back. Dorsal tubercles chrome yellow on the upper end. Rhinophores also tinted chrome yellow. A deep blue band is discernible on the sole in the median line.

Remarks: The present specimen is referred to *Phyllidia varicosa* in the disposition of the warts as well as in the coloration of the back and sole. In this specimen, however, the two longitudinal bands behind the rhinophores are joined together by a series of transverse lines, which is unusual.

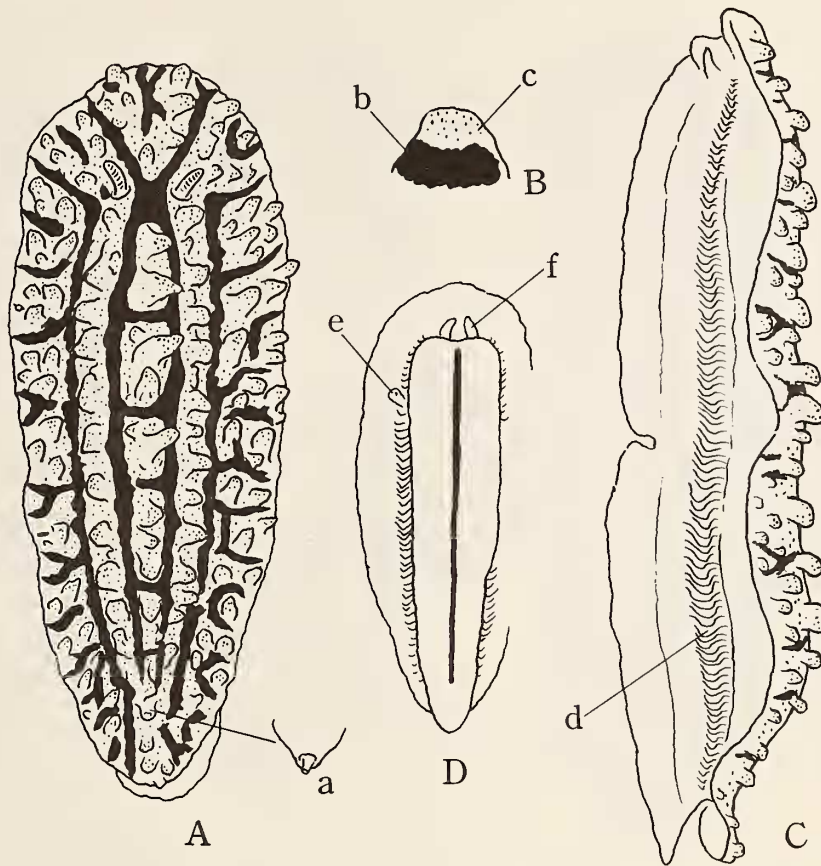


Figure 1

Phyllidia varicosa Lamarck, 1801

from Seto, Kii, Japan

(drawn by I. Hamatani)

A: Living animal from dorsal side, length 100mm

B: A warty tubercle

C: Animal from left side

D: Animal from ventral side

a - anus

b - deep blue base

c - chrome yellow top

d - gill lamellae

e - genital orifices

f - oral tentacles

2. *Phyllidia pustulosa* Cuvier, 1804

(Japanese name: Koibo-umiushi)

(Figures 2, 3)

Main Synonymy:*Phyllidia pustulosa* [*pustulata*]. PRUVOT-FOL, 1956: 61 - 62; fig. III*Phyllidia pustulosa*. BABA, 1949: 71 - 72, 156 - 157; plt. 29, fig. 107. - Sagami Bay**Distribution:** Red Sea (personally communicated by Dr. R. L. Hughes); east coast of Africa; Indian Ocean (the type locality); various stations of the south-western Pacific. This species is known also from Sagami Bay, Japan.**Material Examined:** In all, 8 specimens collected from Seto, Kii, August 15, 1962; December 27, 1962; September 4, 1964; and September 19, 1967.**Brief Description:** Length of the body 30 to 47 mm. The warts on the median part of the back are usually compound,